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This Overlooked Mineral Might Save You From a Heart Attack

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STORY AT-A-GLANCE

- Magnesium is required for the healthy function of most cells, especially your heart, kidneys and muscles
- Low magnesium is a powerful predictor of heart disease, and research shows even subclinical magnesium deficiency can compromise your cardiovascular health
- Low magnesium will impede your cellular metabolic function and deteriorate mitochondrial function, and is a component necessary for the activation of vitamin D
- Top reasons to optimize your magnesium level include optimization and regulation of vitamin D, preventing migraines and depression, improving brain plasticity and protecting your heart health
- Magnesium is also important for the prevention of kidney and liver damage, bacterial and fungal infections, impotence, multiple sclerosis, Alzheimer's disease, premenstrual syndrome, osteoporosis, muscle cramps, Type 2 diabetes and mortality from all causes

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Magnesium is the fourth most abundant mineral in your body and the second most common intracellular cation[1] (positively charged ion) after potassium. It's required for the healthy function of most cells in your body, but is especially important for your heart, kidneys and muscles.

According to one scientific review,[2] which included studies dating as far back as 1937, low magnesium actually appears to be the greatest predictor of heart disease, and other recent research shows even subclinical magnesium deficiency can compromise your cardiovascular health.[3]

Low magnesium will also impede your cellular metabolic function and deteriorate mitochondrial function, and as a component necessary for the activation of vitamin D,[4,5,6] magnesium deficiency may also hamper your ability to convert vitamin D from sun exposure and/or oral supplementation.

While the reasons for prioritizing magnesium could fill several books, here I'll review how it can benefit a few really common health problems and conditions, starting with its influence over vitamin D.

Magnesium Activates and Regulates Vitamin D

Two studies published last year have shed new light on the interactions between magnesium and vitamin D, warning that low magnesium impedes your body's ability to properly utilize vitamin D, even when it's present.[7]

As noted by Mohammed Razzaque, professor of pathology at Lake Erie College of Osteopathic Medicine in Pennsylvania, coauthor of the first study published in The Journal of the American Osteopathic Association in March 2018,[8] "By consuming an optimal amount of magnesium, one may be able to lower the risks of vitamin D deficiency, and reduce the dependency on vitamin D supplements."

A second study,[9] published in The American Journal of Clinical Nutrition in December 2018, also concluded that your magnesium status plays an important role in your vitamin D status. Overall, people with high magnesium intake were less likely to have low vitamin D. They also had a lower mortality risk from cardiovascular disease and bowel cancer.

As explained by Dr. Qi Dai, professor of medicine at Vanderbilt University Medical Center and the lead author of this study, "Magnesium deficiency shuts down the vitamin D

synthesis and metabolism pathway."

What's more, magnesium was found to have a regulating effect, raising and lowering vitamin D based on baseline levels. In people who had a baseline vitamin D level of 30 ng/mL (75 nmol/L) or below, magnesium supplementation raised their vitamin D level. However, in those who started out with higher vitamin D levels (50 ng/mL or 125 nmol/L), magnesium supplementation lowered their vitamin D.

Magnesium Is Recommended for All Migraine Sufferers

According to some statistics,[10] migraine is the third most prevalent illness in the world, affecting an estimated 1 billion people. Migraine attacks are typically recurring, of moderate to severe intensity, many times occurring only on one side of your head.

Along with throbbing, piercing or "burning" pain, other common symptoms include nausea, visual disturbances, dizziness, numbness in your extremities or face, and extreme sensitivity to light, sound, smell and touch.[11,12] While the root cause for migraines continues to be debated, certain nutritional deficiencies have been found to exacerbate the condition, and magnesium deficiency[13,14,15] ranks high on this list, as does vitamin D deficiency.[16,17]

Research shows migraine sufferers are more likely to suffer from magnesium deficiency than non-migraineurs,[18] and since magnesium administration is both easy and safe, researchers have noted that empiric treatment with a magnesium supplement is justified for all migraine sufferers.[19]

In one placebo-controlled study,[20] daily intake of 600 milligrams of magnesium in the form of trimagnesium dicitrate for 12 weeks reduced the frequency of migraine attacks by nearly 42%, compared to less than 16% in the control group.

In many cases, receiving a high dose of magnesium can also abort an attack in progress. The most effective way to administer magnesium for migraine would be to get an intravenous (IV) infusion. Barring that option, magnesium threonate may be your best option for an oral supplement. It has superior absorbability compared to other forms of

magnesium, and its superior ability to cross the blood-brain barrier makes it more likely to have a beneficial effect on your brain.

Magnesium More Effective Than Antidepressants for Depression

Another incredibly common health problem in which magnesium plays an important role is depression, as it acts as a catalyst for mood-regulating neurotransmitters like serotonin. Research[21] published in 2015 found a significant association between very low magnesium intake and depression, especially in younger adults.

Other research[22] published in PLOS ONE demonstrated magnesium supplementation improved mild-to-moderate depression in adults, with beneficial effects occurring within two weeks of treatment. In fact, the effects of magnesium were comparable to prescription SSRIs in terms of effectiveness, but without any of the side effects associated with these drugs.

Participants in the treatment group received a daily dose of 248 milligrams (mg) of elemental magnesium for six weeks, while controls received no treatment. According to the authors, "It works quickly and is well tolerated without the need for close monitoring for toxicity." Emily Tarleton, a graduate student in clinical and translational science and the bionutrition research manager of the University of Vermont's Clinical Research Center, told Science Daily:[23]

> *"This is the first randomized clinical trial looking at the effect of magnesium supplementation on symptoms of depression in U.S. adults. The results are very encouraging, given the great need for additional treatment options for depression, and our finding that magnesium supplementation provides a safe, fast and inexpensive approach to controlling depressive symptoms."*

Magnesium Improves Brain Plasticity

Memory impairment occurs when the connections (synapses) between brain cells diminish. While many factors can come into play, magnesium is an important one. As

noted by Dr. David Perlmutter, a neurologist and fellow of the American College of Nutrition:[24]

> *"It has now been discovered that magnesium is a critical player in the activation of nerve channels that are involved in synaptic plasticity. That means that magnesium is critical for the physiological events that are fundamental to the processes of learning and memory.*
>
> *As it turns out, one form of magnesium, magnesium threonate, has the unique ability to permeate the brain and enhance the receptors that are involved in this process."*

The specific brain benefits of magnesium threonate were demonstrated in a 2010 study[25] published in the journal Neuron, which found this form of magnesium enhanced "learning abilities, working memory, and short- and long-term memory in rats." According to the authors, "Our findings suggest that an increase in brain magnesium enhances both short-term synaptic facilitation and long-term potentiation and improves learning and memory functions."

Magnesium Boosts Heart Health

Magnesium is also important for heart health. As explained by British cardiologist Dr. Sanjay Gupta,[26] magnesium supports heart health via a number of different mechanisms. For starters, it combats inflammation, thereby helping prevent hardening of your arteries and high blood pressure.

It also improves blood flow by relaxing your arteries, and helps prevent your blood from thickening, allowing it to flow more smoothly. All of these basic effects are important for optimal heart function. Indeed, low magnesium has been linked to a higher risk for:

- Hypertension[27]
- Cardiovascular disease
- Arrhythmias

- Stroke[28]
- Sudden cardiac death[29]

A paper in the Open Heart journal warns that even subclinical deficiency can lead to cardiovascular problems. According to the authors:[30]

> *"… 'Various studies have shown that at least 300 mg of magnesium must be supplemented to establish a significantly increased serum magnesium concentrations …' In other words, most people need an additional 300 mg of magnesium per day in order to lower their risk of developing numerous chronic diseases.*
>
> *So while the recommended daily allowance [RDA] for magnesium (between 300 and 420 mg/day for most people) may prevent frank magnesium deficiency, it is unlikely to provide optimal health and longevity, which should be the ultimate goal."*

Magnesium Is Required for Hundreds of Biochemical Reactions

The importance of magnesium becomes even more evident when you consider it is involved in more than 600 different biochemical reactions in your body, which play important roles in:

Creation of adenosine triphosphate (ATP), the energy currency of your body[31,32]
Metabolism of calcium, potassium, zinc, phosphorous, iron, sodium, hydrochloric acid, acetylcholine and nitric oxide, as well as 300 enzymes, and the activation of thiamine[33]
Vitamin D activation and regulation
DNA, RNA and protein synthesis and integrity,[34] and the creation of chromosomes[35]

Mitochondrial function and health. Magnesium is required both for increasing the number of mitochondria in your cells and for increasing mitochondrial efficiency

Regulation of blood sugar and insulin sensitivity, which is important for the prevention of Type 2 diabetes[36,37,38,39] (In one study,[40] prediabetics with the highest magnesium intake reduced their risk for blood sugar and metabolic problems by 71%)

Normalizing blood pressure

Detoxification, including the synthesis of glutathione, considered by many to be your body's most powerful antioxidant

Muscle and nerve function, including the action of your heart muscle

Antioxidant defense via a number of different mechanisms, including anti-inflammatory activity and support of endothelial and mitochondrial function[41]

Maintenance of ionic gradients — keeping intracellular sodium and calcium low and potassium high — and maintaining cellular and tissue integrity[42]

Catalyzing mood-regulating neurotransmitters like serotonin, which helps prevent anxiety and depression

Lowering the damage from electromagnetic fields (EMF) by blocking voltage gated calcium channels

Supporting healthy brain function. Magnesium acts as a buffer between neuron synapses, particularly those involved with cognitive functions (learning and memory).

Magnesium "sits" on the receptor without activating it, protecting the receptor from overactivation by other neurochemicals, especially glutamate, an excitotoxin that can harm your brain if it accumulates

Providing mental and physical relaxation; considered an important stress antidote[43]
Preventing headaches by relaxing blood vessels in your brain and acting as a calcium channel blocker[44]

Other Health Problems Associated With Magnesium Deficiency

Considering the widespread influence of magnesium, it's no great surprise that deficiency can snowball into significant health problems. In addition to what's already been mentioned, other common pathologies associated with magnesium deficiency include:[45,46,47]

Kidney and liver damage
Recurrent or persistent bacterial infections such as sinus, vaginal, middle ear, lung and throat infections due to low levels of nitric oxide
Fungal infections due to depressed immune function
Impotence (also associated with low nitric oxide levels)
Conditions associated with peroxynitrite damage, such as multiple sclerosis, glaucoma and Alzheimer's disease
Premenstrual syndrome, mood swings, aggression and anxiety
Impaired hearing
Osteoporosis
Muscle cramps and muscle weakness
Type 2 diabetes[48,49] — Estimates suggest nearly half of all diabetics are magnesium

deficient.[50] Low magnesium levels also affect insulin resistance, a precursor to Type 2 diabetes.[51] High levels of insulin in the blood, common with insulin resistance, also lead to further loss of magnesium[52]

Increased risk of death from all causes — One 2016 meta-analysis[53] found increasing magnesium intake by 100 mg per day lowered participants' all-cause mortality risk by 10%

Are You Deficient in Magnesium?

When it comes to measuring your magnesium level, keep in mind that a regular serum magnesium is a poor choice, as only 1% of the magnesium in your body is actually found in your bloodstream. Your best bet is to get an RBC magnesium test (which measures the amount of magnesium in your red blood cells) and track your signs and symptoms of magnesium deficiency.

Checking your potassium and calcium levels can also be helpful, as low potassium and calcium are common laboratory signs of magnesium deficiency.[54] Among the more common signs and symptoms of magnesium insufficiency are:[55,56]

Seizures; muscle spasms, especially "charley horses" or spasms in your calf muscle that happen when you stretch your leg, and/or eye twitches

Numbness or tingling in your extremities

Insulin resistance

High blood pressure, heart arrhythmias and/or coronary spasms

Increased number of headaches and/or migraines

Low energy, fatigue and/or loss of appetite

The Trousseau sign[57] — To check for this sign, a blood pressure cuff is inflated around your arm. The pressure should be greater than your systolic blood pressure and maintained for three minutes.

By occluding the brachial artery in your arm, spasms in your hand and forearm muscles are induced. If you are magnesium deficient, the lack of blood flow will cause your wrist and metacarpophalangeal joint to flex and your fingers to adduct. For a video and more information on this hand/wrist position, see RegisteredNurseRn.com[58]

Most People Can Benefit From Magnesium Supplementation

Unfortunately, magnesium insufficiency and deficiency are extremely common around the world, both among adults[59] and teens,[60] in part due to the fact that most people don't eat enough plant foods.

If you frequently eat processed foods, your risk of deficiency is magnified. However, even if you eat plenty of greens (magnesium is actually part of the chlorophyll molecule responsible for the plant's green color), you are unlikely to get enough, due to most foods being grown in mineral depleted soils.

Magnesium absorption is also dependent on having sufficient amounts of selenium, parathyroid hormone and vitamins B6 and D, and is hindered by excess ethanol, salt, coffee and phosphoric acid in soda.

Sweating, stress, lack of sleep, excessive menstruation, certain drugs (especially diuretics and proton-pump inhibitors) also deplete your body of magnesium.[61] For these reasons, most people probably need to take supplemental magnesium. Taking a magnesium supplement is particularly advisable if you:[62]

Experience symptoms of insufficiency or deficiency such as cravings for chocolate, muscle spasms and eye twitches[63]

Have hypertension
Engage in strenuous exercise on a regular basis. Research shows just six to 12 weeks of strenuous physical activity can result in magnesium deficiency,[64] likely due to increased magnesium demand in your skeletal muscle
Are taking diuretics or medication for hypertension, especially thiazides, which have been shown to induce undetectable magnesium deficiency[65] (while patients may have normal or even high serum magnesium, their bodies are actually depleted of magnesium)
Have had or are planning heart transplant or open heart surgery
Are at risk for or have had a heart attack, or if you experience ventricular arrhythmia
Are insulin resistant or diabetic (as this increases magnesium depletion)
Have congestive heart failure

How to Boost Your Magnesium Level

The RDA for magnesium is around 310 to 420 mg per day depending on your age and sex,[66] but many experts believe you may need 600 to 900 mg per day.[67] Personally, I believe many may benefit from amounts as high as 1 to 2 grams (1,000 to 2,000 mg) of elemental magnesium per day, as most of us have EMF exposures that simply cannot be mitigated, and the extra magnesium may help lower the damage from that exposure.

When it comes to oral supplementation, my personal preference is magnesium threonate, as it appears to be the most efficient at penetrating cell membranes, including your mitochondria and blood-brain barrier. Other effective ways to boost your magnesium level include:

- Taking Epsom salt (magnesium sulfate) baths, as the magnesium will effectively absorb through your skin
- Using a topical solution — I prepare a supersaturated solution of Epsom salt by dissolving 7 tablespoons of the salt into 6 ounces of water and heating it until all the salt has dissolved. I pour it into a dropper bottle and then apply it to my skin and rub fresh aloe leaves over it to dissolve it. This is an easy and inexpensive way to increase your magnesium and will allow you to get higher dosages into your body without having to deal with its laxative effects.

Magnesium can be taken with or without food. If you're also taking calcium, take them together. If you exercise regularly, consider taking your calcium and magnesium in a ratio of one part calcium to two parts magnesium with your pre-workout meal.

While the ideal ratio of magnesium to calcium is thought to be 1-to-1, most people get far more calcium than magnesium from their diet; hence, your need for supplemental magnesium may be two to three times greater than calcium.

Eat More Magnesium-Rich Foods

Last but not least, while you may still need magnesium supplementation (due to denatured soils), it would certainly be wise to try to get as much magnesium from your diet as possible. Dark-green leafy vegetables lead the pack when it comes to magnesium content, and juicing your greens is an excellent way to boost your intake. Greens with the highest magnesium levels include:

Spinach	Swiss chard	Turnip greens
Beet greens	Collard greens	Broccoli
Brussel sprouts	Kale	Bok Choy
Romaine lettuce		

Other foods that are particularly rich in magnesium include:[68]

Raw cacao nibs and/or unsweetened cocoa powder — One ounce (28.35 grams) or raw cacao nibs contain about 65 mg of magnesium.

Avocados — One cup of avocado on average (values differ depending on whether they come from California or Florida) contains about 44 mg of magnesium. Avocados are also a good source of potassium, which helps offset the hypertensive effects of sodium.

Seeds and nuts — Pumpkin seeds, sesame seeds and sunflower seeds score among the highest, with one-quarter cup providing an estimated 191 mg, 129 mg and 41 mg of magnesium respectively. Cashews, almonds and Brazil nuts are also good sources; one-fourth cup of cashews contains 89 mg of magnesium.

Herbs and spices — Herbs and spices pack lots of nutrients in small packages and this includes magnesium. Some of the most magnesium-rich varieties are coriander, chives, cumin seed, parsley, mustard seeds, fennel, basil and cloves.

Organic, raw grass fed yogurt and natto — Choose yogurt made from raw organic grass fed milk with no added sugars; 1 cup of natto yields 201 mg of magnesium.

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